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# Attention in Relation to Coding and Planning in Reading

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**Abstract**
A group of 50 skilled readers and a group of 50 less-skilled readers of Grade 5 matched for age and intelligence and selected on the basis of their proficiency in reading comprehension were tested for their competence in word reading and the processes of attention, simultaneous coding, successive coding and planning at three levels, i.e., perceptual, memory, and conceptual in order to study the relationship of attention with the processes of coding and planning at these levels and their contribution to the reading achievement of children. Results of *t* test and correlational analysis suggest that all the processes are related significantly to the two skills of reading at conceptual level, whereas, successive coding and planning are related significantly to reading at perceptual and memory level also. Attention, the basic cognitive process, at the same time showed significant relationship with simultaneous processing at all the three levels, whereas, conceptual attention was found to have significant relationship with successive processing at memory level and planning at conceptual level. The results have been discussed in terms of functional aspects of the brain structures underlying cognitive activities including reading and suggestions have been made for the remediation of reading difficulties of children.
**Keywords:** Skilled reader, Less-skilled reader, Cognitive processes.

## 1. Introduction

Proficiency in reading demands mastery over two different skills : a) word reading and b) reading comprehension. The two skills, of course, are highly related, yet, sub skills within each component and disorders related to reading weaknesses differentiate the two components (Oakhill, Cain, & Bryant, 2003). Researches carried out within the framework of PASS model of intelligence (Naglieri& Das, 1988, 1990) have established that Planning, Attention , Simultaneous and Successive (PASS) processes are importantly involved in reading. Attention being the basic prerequisite of all intellectual functions helps the readers to focus on relevant information to the exclusion of the irrelevant ones and also makes way for efficient coding that may be either simultaneous or successive or both. In fact, a cyclical hierarchy of involvement of both simultaneous and successive processes is seen in the entire process of reading. Successive coding involves sequential processing of linguistic input which serves as a prerequisite for deeper level of semantic analysis of the same that involves simultaneous processing. Mastery over the two skills ultimately makes way for emergence of appropriate reading strategies in which planning plays a crucial role. As has been observed, a weakness in simultaneous processing in children is linked with comprehension difficulties, whereas, word decoding difficulties are associated with a successive processing weakness in beginning readers. Planning, and attention, on the other hand, are necessary at all levels of reading and their importance increases as a function of complexity of the reading task. (Das, Naglieri& Kirby, 1994; Das, Parrila, & Papadopoulos,2000; Kirby et al.,1996; Mahapatra, 1989, 1990; Mahapatra& Dash, 1999; Naglieri& Das, 1990).

The PASS theory postulates that each of the four processes, i.e., planning, attention, simultaneous and successive can occur in three varieties, namely, perceptual, memory and conceptual, which of course, are interdependent, but vary from one another with respect to the degree of abstraction involved in them. Perceptions are closest representations of objects and events, whereas, memory and conceptualization are a bit removed from direct apprehension through sense organs. From this point of view a hierarchy in their arrangement may be assumed with perception at the bottom, conceptualization at the top and memory, in-between.

Planning as a higher order cognitive process regulates attention, determines the nature of coding and helps to use the coded information in the most effective manner so as to reach the goal. Conversely, a minimum level of arousal is needed so as to select and attend to the desired information that may help one to code it properly and use it in a manner so that the goal can be attained. The three processes, therefore, are closely interrelated and determine one's proficiency in reading in a collaborative manner although the ultimate level of reading achievement is determined by planning , the higher order cognitive process which Das (1984a) views to be the essence of human intelligence. Yet, we do not know as how the PASS processes at different levels relate to one another and in what way they contribute to one's reading achievement.

Keeping in view the above facts, the present investigation was carried out with a purpose of studying the relationship of attention, coding and planning processes with reading achievement by examining the proficiency of skilled and less-skilled readers in these processes at perceptual, memory and conceptual levels and the relationship of attention, the basic cognitive process with the other two at the three levels. It was expected

that skilled readers would be found superior to their less skilled counterparts in all the three processes at memory and conceptual levels though not at perceptual level and reading would show substantial relationship with the three processes at these levels. Attention, of course, would show close relationship with coding and planning because the processes are interrelated, but what would be the nature of this relationship at their various levels was to be seen.

## 2. Method

### *2.1 Sample*

The study involved a sample of 100 children, 50 skilled readers and 50 less-skilled readers of Grade 5 selected from a population of 350 children of the same grade covering four Odia medium schools in the city of Cuttack, Odisha. The standard of education imparted was almost equal in all these schools. All children were first administered the Raven's Coloured Progressive Matrices Test for the assessment of their intelligence and those who scored within $40^{th}$ to $60^{th}$ percentile points on the RCPM were further examined for their reading competence using the Graded Reading Comprehension Test (Mohanty&Sahu, 1985) and finally 100 subjects, i.e., 50 skilled readers and 50 less-skilled readers were selected. The mean RCPM scores of the skilled and the less-skilled readers were 25.34 and 24.98 respectively, whereas, the mean reading grade level of the skilled readers was 5.9 and that of the less-skilled readers was 2.9. Thus, the skilled readers, on an average, scored about 1 grade above, whereas, the less-skilled readers scored about 2 grades below their actual grade level on the test of reading even if all of them were within the normal range of intelligence having no neurological, psychiatric or other serious medical problems. Moreover, the skilled and the less-skilled readers came from the same age-bracket (9-11 yrs. ) and from both the sex groups. The subjects were mostly from middle class families.

### *2.2 Tests*

The skilled and the less-skilled readers were selected on the basis of their intelligence and reading competence as measured by Raven's Coloured Progressive Matrices and Graded Reading Comprehension Test respectively. Each subject, then, received the Oral Reading Test, a measure of word decoding skill and a series of cognitive tests designed to tap the planning, attention, simultaneous and successive (PASS) processes. The tests of planning were Matching Numbers, Planned Composition and Tests of Attention were Selective Attention-Receptive and Auditory Selective Attention. Figure Memory and Tokens Test, on the other hand, were simultaneous tests, whereas, successive processing tests were Serial Recall and Naming Time. The tests of each of the four processes were so designed that their items incorporated all the three components, i.e., perceptual, memory and conceptual with some component(s) dominating over the other(s) in each of them.

All the cognitive tests except serial Recall and Planned Composition were selected from the test battery known as Cognitive Assessment System (Naglieri& Das, 1987,1988). All the tests have been used within the framework of the PASS model to study the cognitive characteristics of different groups of subjects.The tests, their administration and scoring procedures are described below.

Raven's Coloured Progressive Matrices (RCPM).This is a widely used culturally reduced test of intelligence for children aged 5 to 11 years. Consisting of 36 matrices or designs, each having a part which has been removed, the test requires the subject to choose the missing part from six possible alternatives. The 36 matrices are grouped into three series and each series is comprised of 12 matrices of increasing difficulty. Each correct identification carries a score of '1'. Hence the maximum possible score for this test is 36.

Graded Reading comprehension Test. Developed by Mohanty and Sahoo (1985), this test is used for children of Grade 1 through 7. The subject is given to read some passages written in Odia, on each of which some questions are asked. A score of '1' is given for each correct answer with the maximum score for the test being 86. The obtained score is then converted into a grade score. The test is discontinued following subject's failure to answer any of the questions for a passage.

Oral Reading Test.This is an Odia adaptation of Schonell's Word Reading Test which was used by Dash (1982). The test consists of one hundred Odia words of varying complexity and difficulty which the subject is required to read aloud. A score of '1' is given for each correct pronounciation, with the maximum score for the test being 100. The test is discontinued with 10 consecutive errors, i.e., the incorrect pronounciations.

Matching Numbers.This is a non verbal marker test of planning which measures planning at both perceptual and memory level. The test is divided into three parts each part containing eight rows of numbers. The numbers vary in length across the parts, but each row in each part consists of six numbers, two of which are identical. The subject's task is to find and underline the pair in each row, within a time limit of two minutes per part. Score on the test corresponds to the number of pairs identified correctly. The maximum possible score for the test is 24.

Planned Composition.This is a verbal marker test of planning measuring the process at conceptual level. The test requires the subject to write a story after seeing a picture card. The picture card used in the present

study was card no. 2 of the Thematic Apperception Test (TAT). The story written (in Odia in the present study) by the subject is rated by the Investigator for 'expression', 'organization' and 'individuality'. The maximum score for each aspect is 7. Hence, the maximum possible score for the test is 21.

Receptive Selective Attention.This visual test of selective attention consists of two conditions, namely, physical match and name match, the first of which measures attention at perceptual level, whereas the second one measures the process at conceptual level. In each condition some picture pairs printed on a sheet are shown to the subject. The subject's task is to identify the pairs that look same (e.g. 2 roses, 2 dogs etc.) in physical match condition and those which belong to same class (e.g. 2 flowers, 2 animals etc.) in name match condition. Each correct identification carries a score of '1'. The maximum possible score for this test is 20 per condition as there are 20 such pairs in each condition of the test.

Auditory Selective Attention. This test is organized into two conditions the first of which measures attention at perceptual level, whereas, the second one measures the process at conceptual level. In Condition I, the subject listens to a tape recording of some 'colour' and 'fruit' words in both male and female voices and is required to tap hand on the table by hearing the man saying the 'fruit' words. But in Condition II, the subject listens to some 'animal' and 'flower' words in both male and female voices and is to tap hand by hearing the man saying the 'animal' words and the woman, the 'flower' words. Both correct and incorrect responses are recorded in each condition and the score is calculated by deducting one-third of the incorrect responses from the total number of correct responses in each condition.

Figure Memory. This is a nonverbal marker test of simultaneous processing and measures the process predominantly at memory level. It consists of 20 items in the form of simple geometric patterns. The subject's task is to remember each pattern within a period of 5 seconds and subsequently locate and outline the same as embedded within a more complex pattern. A score of '1' is given for each perfect outline, with the maximum score for the test being 20. The test is discontinued after 4 consecutive failures.

Tokens Test. This marker test of simultaneous processing measures the particular process at conceptual level. The test consists of 4 round and 4 square pieces from each of blue, black, yellow and white colours, 26 verbal statements and a response sheet. The subject's task is to produce the pattern as specified in the statement by using the concepts of 'shape' and 'colour' in various combinations. Each correct response carries a score of '1' with the maximum score for the test being 20. The test is discontinued after failure on 4 consecutive items.

Serial Recall. This marker test of successive processing which was used in Odia, measures the particular process at memory level. The test was used earlier by Dash (1982). The test consists of 12 sets of words, four from each of four-word, five-word and six-word series. After one presentation of each series, the subject is asked to recall it in correct serial order. The total number of words recalled in correct serial position constitutes the serial recall score of the subject. The maximum possible score for this test is 60.

Naming Time. *This* is a marker test of successive processing and measures the particular process at perceptual level. The test consists of 2 cards with numbers arranged in the form of a 2 digital matrix in one of them and in the form of a 3 digital matrix in the other. The subject is required to read aloud the numbers at his/her quickest pace taking care not to commit mistakes. The time taken to read the numbers and the number of errors committed are recorded from which the mean time for the numbers correctly read is calculated and is used as the score of the subject on the test.

### *2.3. Procedure*

The tests were administered to the subjects in their respective schools in Cuttack town. Permission for the same was obtained from the District Inspector of Schools as well as the Head-Masters of the concerned schools. The teachers also extended their cooperation in the matter. The tests were administered by the author herself in a separate room in each school provided by the Head-Masters of those schools. Maximum care was taken to keep the subjects away from the external disturbances during the test administration.Test administration was carried out individually in Odia, the regional language of Odisha following establishment of adequate rapport with the subjects and exposure to few practice items. The tests were administered as per the rules given in the manuals developed for the same and each subject was tested in two different sessions which were one day apart. Thus, the tests of intelligence and reading comprehension were administered in the first session.. Those selected on these tests received the rest of the tests in the second session.. The order of the tests in the two sessions was the same as described in this section. The testing time for each subject was approximately 2 hours 50 minutes and the entire testing period ranged over 7 months.

## 3. Results

Considering the objective, the data of the present study were analyzed by means of 't' test and correlational analysis . The results have been presented in separate tables.

*Results of 't' tests*

The subjects following their selection on the basis of their scores on tests of RCPM and Graded

 

Reading Comprehension were tested for their word decoding skill being administered the Oral Reading Test. The Means, Standard Deviations and *t* values in respect of these tests are presented in Table 1.

TABLE 1 **Means, Standard Deviations and *t* Values Showing Group Differences on Measures of Intelligence and Reading (N = 50 in each group)**

| Test | | Skilled Readers | Less-skilled Readers | t |
|---|---|---|---|---|
| RCPM | Mean | 25.34 | 24.98 | 1.15 |
| | SD | 1.51 | 1.62 | |
| Graded reading Comprehension | Mean | 70.00 | 32.52 | 20.18** |
| | SD | 4.56 | 12.32 | |
| Oral Reading | Mean | 69.34 | 55.90 | 4.75** |
| | SD | 11.74 | 16.20 | |

**p < .01

It may be seen from Table 1 that skilled readers who were matched to their less-skilled counterparts in terms of intelligence differed significantly from them with respect to their competence not only in reading comprehension but also in word reading. Word reading and reading comprehension are, of course, two different, skills, but as is known, word reading which involves word decoding is the basic skill of reading that indicates the reader's facility in lexical access. The correlation coefficients between word reading and reading comprehension were 0.31, 0.33 and 0.51 for the skilled, the less-skilled and the combined group of skilled and less-skilled readers respectively. All the correlations were significant indicating the relationship between the two skills of reading. The skilled and the less-skilled readers then were tested for their competence in the processes of planning, attention, simultaneous coding and successive coding. The means, Standard deviations and *t* values in respect of these tests are presented in Table 2.

TABLE 2 **Means, Standard Deviations and *t* Values Showing Group Differences on Measures of Attention, Simultaneous Processing, Successive Processing, and Planning (N = 50 in each group)**

| Test | | Skilled Readers | Less-skilled Readers | t |
|---|---|---|---|---|
| Receptive Selective Attention | | | | |
| Physical Match | Mean | 19.58 | 19.08 | 1.77 |
| | SD | 1.06 | 1.70 | |
| Name Match | Mean | 16.50 | 14.28 | 3.25** |
| | SD | 3.11 | 3.69 | |
| Auditory Selective Attention | | | | |
| Condition I | Mean | 56.80 | 52.85 | 1.47 |
| | SD | 11.37 | 15.23 | |
| Condition II | Mean | 40.35 | 34.11 | 2.39* |
| | SD | 11.14 | 14.68 | |
| Simultaneous | | | | |
| Figure Memory | Mean | 9.92 | 9.22 | 1.86 |
| | SD | 1.75 | 2.00 | |
| Tokens | Mean | 8.70 | 5.14 | 4.98** |
| | SD | 3.65 | 3.49 | |
| Successive | | | | |
| Serial Recall | Mean | 45.18 | 35.90 | 4.89** |
| | SD | 7.31 | 11.25 | |
| Naming Time | Mean | 1.75 | 2.09 | 1.51 |
| | SD | 1.19 | 1.03 | |
| Planning | | | | |
| Matching Numbers | Mean | 21.74 | 20.22 | 2.71** |
| | SD | 2.25 | 3.27 | |
| Planned Composition | Mean | 12.26 | 7.26 | 7.43** |
| | SD | 3.76 | 2.92 | |

p < .05 , ** p< .01

It may be seen from Table 2 that the two groups differed significantly from each other with respect to

their performance on name match task of the receptive measure and condition II task of the auditory measure of attention both of which demand semantic categorization of items and shifting attention in between them while responding to the desired stimuli eliminating the distractors. Both the tasks, thus, require attention to operate predominantly at conceptual level in which the skilled readers were superior to their less-skilled peers.

It may be seen from the same table that the skilled readers differed significantly from the less-skilled readers with regard to their performance on Tokens Test, a simultaneous task that requires solution of problems through abstract thinking and reasoning dealing with the concepts of 'shape' and 'colour' in various combinations and thus demands simultaneous process to operate at conceptual level. In case of successive processing, on the other hand, the two groups differed significantly from each other on the test of Serial Recall which requires the subjects to listen, remember and reproduce words in their correct sequence and thus measures the process at memory level.

It may be seen further from Table 2 that the skilled readers differed significantly from their less-skilled counterparts on both the measures of planning, namely, Matching Numbers and Planned composition. Matching Numbers involves controlled and strategic search of similar pairs of numbers and thus, measures planning at both perceptual and memory levels. Planned composition, on the other hand, requires organization and expression of ideas on the basis of existing knowledge and available information and thus, measures planning at conceptual level.

*Correlational Analysis*

The relationship of oral reading and reading comprehension with the PASS processes at their various levels was studied by means of corelational analysis, the results of which are presented in Tables 3.

TABLE 3 **Correlation, Coefficients for Measures of Reading and Cognitive Processes for Skilled and Less-skilled Readers (N=100)**

| Test | Sel. Attn. (Rec:PM) | Sel. Attn. (Rec:NM) | Aud. Sel. Attn. (C1) | Aud. Sel. Attn. (C2) | Fig. Mem. | Tok. Test | Ser. Rec. | Nam. Time | Mat. Num. | Plan. Comp. |
|---|---|---|---|---|---|---|---|---|---|---|
| Oral Reading | .16 | -.15 | .22* | .32** | .11 | .45** | .45** | -.36** | .23*. | 55** |
| Graded Reading Comprehension | .04 | -.27** | .19 | .28** | .19 | .55** | .47** | -.29** | .17 | .65** |

*p < .05, **p < .01

As is evident from Table 3, Oral Reading was significantly related to both the tasks of Auditory Selective Attention measure, one of the simultaneous measures (Tokens Test), and all the successive and planning measures. Reading comprehension, on the other hand, correlated significantly with one of the two tasks of each of the receptive (name match task) and the auditory (condition II task) measure of selective attention, one simultaneous measure (Tokens Test), both the successive measures and one planning measure (Planned Composition).

The general trend of the results, thus, suggests a close relationship between reading and PASS processes. However, all the processes are found to be significantly related to both word reading and reading comprehension at conceptual level, whereas, successive processing and planning are found to have significant relationship with the two reading skills at perceptual and memory level also.

It may, however, be noted that attention is a basic cognitive process and thus, works behind all intellectual operations. Hence, its relationship with the processes of simultaneous and successive coding as well as planning at their various levels was further analyzed in order to know about the specific contribution of each of these processes to the reading achievement of children. These results are presented in Table 4.

 

TABLE 4 **Correlation, Coefficients for Measures of Attentionand Measures of Coding and Planning (N=100)**

| Test | Fig. Mem. | Tok. Test | Ser. Rec. | Nam. Time | Mat. Num. | Plan. Comp. |
|---|---|---|---|---|---|---|
| Sel. Attn. (Rec:PM) | -.12 | .22* | -.03 | -.05 | .07 | .07 |
| Sel. Attn. (Rec:NM) | .22* | .35** | .26** | -.07 | .19 | .35** |
| Aud. Sel. Attn. (C1) | .25* | .27** | .07 | -.12 | .29** | .23* |
| Aud. Sel. Attn. (C2) | .31** | .25* | .20* | -.19 | .19 . | 34** |

*P<.05 , **P<.01

It may be seen from Table 4 that physical match task of Receptive Selective Attention measure correlated significantly with one of the simultaneous measures (Tokens Test), whereas, name match, the other task of the same measure correlated significantly with both the simultaneous measures, one of the successive measures (Serial Recall) and one of the planning measures (Planned composition). Similarly, the condition I task of Auditory Selective Attention measure showed significant relationship with all the simultaneous and planning measures, whereas, the condition II task of the same measure showed significant relationship with the two simultaneous measures, one successive measure (Serial Recall) and one planning measure (Planned composition).

The results, thus, reveal a meaningful relationship of attention with simultaneous and successive coding as well as panning. With respected to the levels of the processes it may further be mentioned that attention whether receptive or auditory is strongly related to simultaneous processing at all the three levels, i.e., perceptual, memory, and conceptual, whereas, conceptual attention, particularly, reveals a strong relationship with successive processing at memory level and with planning, at conceptual level.

## 4. Discussion & Conclusion

The present investigation was carried out with a purpose of studying the relationship of attention, coding and planning processes with reading achievement by examining the proficiency of skilled and less-skilled readers in these processes at perceptual, memory and conceptual levels and the relationship of attention, the basic cognitive process with the other two at the three levels.

*Attention in relation to coding and planning in reading*

Skilled readers compared to their less-skilled peers were superior not only in reading comprehension but also in word reading and in the processes of attention, coding and planning at memory and conceptual levels but not at perceptual level. All the processes, at the same time, showed substantial relationship with the two skills of reading at conceptual level, whereas, two of them, namely, successive processing and planning were found to be markedly related to reading at perceptual and memory level also. The hypothesis framed in this connection, therefore, is supported. The relationship of attention, the basic cognitive process with the processes of coding and planning further revealed that it is substantially related to simultaneous processing at all the three levels, i.e. perceptual, memory and conceptual, whereas, conceptual attention is closely related to successive processing at memory level and to planning at conceptual level.

The involvement of PASS processes in the acquisition of reading skills has already been established in a number of earlier studies carried out both in Western and Indian set up (Das, 2001; Das, Kar, &Parrila, 1996; Das, Naglieri, & Kirby, 1994; Das, Parrila& Papadopoulos, 2000; Dash and Dash, 1999; Kirby & Das, 1990; Mahapatra, 1989, 1990; Mahapatra, & Dash, 1999). The findings of the present study provide a line of support to it and additionally reveal a higher level operation of these processes in reading at advanced level.

The basic prerequisite of reading is decoding and word recognition which involves reactivation of

 

phonological, syntactic and semantic representations of the written language in long term memory. These representations, therefore, are to be fully and correctly specified in the memory. Otherwise, they will be mispronounced, will not be brought to the mind easily and will be forgotten when their memorization will be needed. But, what is more important is the ability to perceive the relationship among the bits of information obtained from separate words to understand the sentence, from sentences to understand the paragraph and from paragraph to comprehend the text ultimately. Coding and storing of information at the mental level, therefore, should also be as accurate as possible. The reader, for that matter, is required to have special sensitivity to certain information among others and the ability to shift attention in between them. This control over attention and coding processes is achieved by planning which operates on them as a higher order process in conjunction with knowledge base while dealing with the task at hand. In fact, in most cases the inability to use appropriate strategies to select, code and use the available information seems to be combined with an inadequate knowledge of vocabulary, syntactic and semantic rules to give rise to reading deficits among poor readers. Skilled readers, on the other hand, keeping in view the purpose of reading develop their own plans and strategies of mastering the content of the text and become adept in deliberate application of that knowledge in remarkably flexible ways. The more efficient and parsimonious the plan is, the more effective is the outcome. For this, they seem to operate more at conceptual level than at memory and perceptual levels while using the PASS processes as is evident in the present study. This seems to make their attentional process more efficient through which they focus on meaning of individual words, their arrangement in the sentences, the content of the text and the style of its presentation operating more at an abstract level while going through the text. This gives way not only to select the relevant information from among the irrelevant ones, but also to choose an efficient mode of coding and storing the information and use it in the most appropriate manner when the time comes. In the present study skilled readers used conceptual simultaneous coding more for both word reading and reading comprehension, whereas, less-skilled readers used successive processing more at perceptual and memory levels for the two skills of reading. Advanced level of reading, thus, seems to depend more on conceptual linguistic operations and imagery based memory than sequential memorization of linguistic information. This, in turn, helps them to modify their existing cognitive structures or even to develop new ones and thereby strengthen their knowledge base through which their subsequent reading becomes more active and effective. Thus, while reading, conceptual panning automatically makes way for attention and coding to be employed at conceptual level making the attainment of goal smoother and easier for skilled readers.

*Topographical processing in the brain and levels of PASS processes*

The PASS theory of intelligence is rooted in the work of A.R.Luria (1966, 1973, 1980) whose research on the functional aspects of brain structures formed the basis of the theory (Das, Naglieri& Kirby, 1994). Luria, theorized that attention-arousal, coding and planning processes are carried out in three different blocks or functional units of the brain. Thus, attention-arousal is the function of Block 1 or the first functional unit that includes brain stem, diencephalon and medial regions of the hemispheres. Information coding is carried out in the second unit or Block 2 that incorporates parietal, occipital and temporal lobes posterior to the central sulcus with simultaneous processing being carried out in the occipito-parietal areas and successive processing, in the fronto-temporal areas of the cortex. Finally, planning is carried out in the third functional unit of the brain or Block 3 that entails the frontal, especially the pre-frontal areas of the cortex. Luria views that these functional units work in concert. Hence, insufficient performance of the first unit that controls attention automatically leads to difficulty with information coding and planning as well as difficulty in selective and organized responding. In fact, it is viewed that there is direct neural connection between the first and the third functional units of the brain (Luria, 1980, Stuss and Benson, 1986). The key point of this theorization, however, is that these functional units have both 'spread' and 'depth'. Thus, not only the three functional units and their underlying neurophysiological structures spread over a wide area of cortical and sub cortical regions, but each unit is also hierarchical in structure. Luria views that three cortical zones, namely primary (projection), secondary (projection-association) and tertiary (zones of overlapping), one upon the other are assumed to control the functions of each unit. The primary zone retains the modality characteristics of the information it receives which diminishes in the secondary zone. The information in the tertiary zone, on the other hand, is typically amodal. In fact, at this level all sensory tags are removed from the information because it is responsible to integrate all information that has already been coded. This topographical analysis of information processing in the brain as suggested by Luria seems to fit well into the fact that the PASS processes operate at three levels, i.e., perceptual, memory and conceptual that are interdependent but maintain a hierarchy according to the degree of abstraction they involve. Higher level mental operations underlying ones performance in a particular field including reading, thus, seems to be the product of functional efficiency of a structurally well equipped brain.

The PASS processes, however, are mutable. Hence, basing upon the PASS theory, a reading remediation programme, PREP (PASS Reading Enhancement Programme) has been developed in English and implemented successfully to improve both word reading and reading comprehension skills of children (Boden&

Kirby, 1995; Carlson & Das, 1997; Das, Mishra & Pool, 1995; Mahapatra, Das, Stack-Cutler &Parrila, 2010; Mohanty, 2007; Papadopoulos, Das, Parrila, & Kirby, 2003). The findings of these studies suggest that PREP works equally efficiently in case of children who are the native speakers of English language and those who use English as their second language (ESL children) like the children of Odisha. But, we are yet to see the long term effects of this programme. The findings of the present study may contribute to the field in that direction.

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